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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/544,344	04/06/2000	Arthur W. Snow	0064612-0010	8024

7590 12/12/2001

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EXAMINER	
SODERQUIST, ARLEN	
ART UNIT	PAPER NUMBER
1743	4

DATE MAILED: 12/12/2001

Please find below and/or attached an Office communication concerning this application or proceeding.

mk-4

Office Action Summary

Application No.	Applicant(s)
09/544,344	Snow et al.
Examiner	**Art Unit**
Arlen Soderquist	1743

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136 (a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1) ☐ Responsive to communication(s) filed on _____.

2a) ☐ This action is **FINAL.** 2b) ☒ This action is non-final.

3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11; 453 O.G. 213.

Disposition of Claims

4) ☒ Claim(s) *1-9 and 21-36* is/are pending in the application.

4a) Of the above, claim(s) _____ is/are withdrawn from consideration.

5) ☐ Claim(s) _____ is/are allowed.

6) ☒ Claim(s) *1-9 and 21-36* is/are rejected.

7) ☐ Claim(s) _____ is/are objected to.

8) ☐ Claims _____ are subject to restriction and/or election requirement.

Application Papers

9) ☐ The specification is objected to by the Examiner.

10) ☐ The drawing(s) filed on _____ is/are objected to by the Examiner.

11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved.

12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. § 119

13) ☐ Acknowledgement is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d).

a) ☐ All b) ☐ Some* c) ☐ None of:

1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

*See the attached detailed Office action for a list of the certified copies not received.

14) ☒ Acknowledgement is made of a claim for domestic priority under 35 U.S.C. § 119(e).

Attachment(s)

15) ☐ Notice of References Cited (PTO-892)
16) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
17) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s). 4
18) ☐ Interview Summary (PTO-413) Paper No(s). _____
19) ☐ Notice of Informal Patent Application (PTO-152)
20) ☐ Other:

1. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless --
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

2. Claims 1- 5, 7 - 9, 21- 26, and 33 - 34 are rejected under 35 U.S.C. 102(b) as being anticipated by Bethell (*J. Electroanal. Chem.*). In the paper Bethell describes simple methods for the production of Au nanoparticles with narrow size distributions by reduction of tetrachloroaurate solutions in the presence of thiol-containing organic compounds which self-assemble on the Au surface. Stable solutions of somewhat larger particles can be produced if the thiol is absent. The thiol-derivatized materials are stable in air over long periods and can be handled in much the same way as simple organic compounds. Using dithiols as the derivatizing spacer units, methods were developed for the preparation of materials in 3-dimensional form and as thin films attached to a solid substrate (figure 3). Such materials show conductivities that mimic the behavior of semiconductors and that depend markedly on the structure of the dithiol used to link the Au particles together. Thus there is inherently a structure capable of being used to measure conductivity. The increase in conductivity with increasing temperature probably involves activated electron hopping from particle to particle. Surfaces treated with a coating of the materials show electroreflectance changes with applied potential that also differ according to the structure of the dithiol spacer. Unusual effects were observed on heterogeneous electron transfer from electrode surfaces treated with layers of the Au nanoparticles and dithiol spacers. Applications for these nanostructured materials can be envisaged, which range from submicroelectronic devices and circuitry to electrical modification of the reflectance of glass. Such applications will require a multidisciplinary approach with a substantial organic chemical research input. Section 4 and figure 5 discuss other methods of making the clusters which use multi-functional groups on the ligand layer surrounding the metal core.

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

The factual inquiries set forth in *Graham* v. *John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

4. Claims 2, 4, 6, and 22 are rejected under 35 U.S.C. 103(a) as being unpatentable over Bethell as applied to claims 1 and 22 above, and further in view of Natan (US 5,609,907). Bethell does not teach other types of metal colloids or the use of amine functions in the coating materials.

In the patent Natan teaches the formation of self-assembled metal colloid layers. Figure 1A with its associated discussion teach that the colloids can be gold, silver or other suitable metals. Column 3, lines 39 - 59 and the brief description of Figures 1A and 1B teach the additional use of amine and other functional groups in addition to thiols used to immobilize the colloids on a surface. The brief discussions of the figures also includes colloids having two layers of metal. Figure 1D shows the various levels of self-assembled colloids including multilayered (bulk).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to incorporate the metal cores and metal interacting functional groups of Natan into the self-assembled colloid structures of Bethell because as shown by Natan the specifically claimed metals and functional groups would have been recognized as functional equivalents to those of Bethell relative to the formation of the self assembled colloid layers.

5. Claims 27 - 32 and 35 - 36 are rejected under 35 U.S.C. 103(a) as being unpatentable over Bethell as applied to claims 1- 5, 7 - 9, 21- 26, and 33 - 34 above, and further in view of Terrill. Bethell does not teach the type of electrode used or the measurement equipment used.

In the paper Terrill discusses NMR, SAXS, Thermal, and Electron Hopping Studies of alkanethiol stabilized gold cluster monolayers in three dimensions. Au clusters stabilized by chemisorbed monolayers of octane-, dodecane-, or hexadecanethiolate were studied in solution and in the solid phase. These materials can be pumped free of solvent to form a dark brown solid that can be re-dissolved in nonpolar solvents. Their exceptional stability suggests that they may be viewed as cluster compounds. The self-assembled alkanethiolate monolayers stabilizing the metal clusters can be studied by using techniques that are insufficiently sensitive for study of a monolayer on a flat surface (e.g., ^{1}H and ^{13}C NMR, elemental analysis, DSC, thermogravimetry (TGA), diffusion-ordered NMR spectroscopy (DOSY)). Results from such measurements (combined with SAXS data on solutions of the clusters and AFM and STM images) are consistent with a small, monodisperse (12 Å radius) Au core, which modeled as a sphere contains ~ 400 Au atoms and ~ 126 alkanethiolate chains, or if modeled as a cuboctahedral structure contains 309 Au atoms and ~ 95 alkanethiolate chains. High-resolution NMR spectra of cluster solutions display well-defined resonances except for methylenes nearest the Au interface; the absence of the latter resonances is attributed to a combination of broadening mechanisms based on the discontinuous change in magnetic susceptibility at the metal-hydrocarbon interface and residual dipolar interactions. Films of the dry, solid cluster compound on interdigitated array electrodes (see pages 12538-12539, experimental section for preparation and measurements) exhibit current-potential responses characteristic of electron hopping conductivity in which electrons tunnel from Au core to Au core. The electron hopping rate decreases and the activation barrier increases systematically at longer alkane chain length. The results are consistent with electron transport rate control being a combination of thermally activated electron transfer to create oppositely charged Au cores (cermet theory) and distance-dependent tunneling (β = 1.2 Å-1) through the oriented alkanethiolate layers separating them. See pages 12545 - 12548 for a discussion of the electrical measurements.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to incorporate the electrodes and measurement apparatus of Terrill into the formation

method of Bethell because of their known use and sensitivity for measuring resistivity of self-assembled colloid clusters as shown by Terrill.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Arlen Soderquist whose telephone number is (703) 308-3989. The examiner's schedule is variable between the hours of about 5:30 AM to about 5:00 PM on Monday through Thursday and alternate Fridays.

For communication by fax to the organization where this application or proceeding is assigned, (703) 305-7719 may be used for official, unofficial or draft papers. When using this number a call to alert the examiner would be appreciated. Numbers for faxing official papers are 703-872-9310 (before finals), 703-872-9311 (after-final), 703-305-7718, 703-305-5408 and 703-305-5433. The above fax numbers will generally allow the papers to be forwarded to the examiner in a timely manner.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0661.

Arlen Soderquist

December 12, 2001

ARLEN SODERQUIST
PRIMARY EXAMINER